

Human Body Systems and Disease

7-3 The student will demonstrate an understanding of the functions and interconnections of the major human body systems, including the breakdown in structure or function that disease causes. (Life Science).

7.3.1 Summarize the levels of structural organization within the human body (including cells, tissues, organs, and systems).

Taxonomy level: 2.4-B Understand Conceptual Knowledge

Previous/Future knowledge: In 4th grade (4-2.3), students explained how humans use their sensory organs. In 5th grade (5-2.1), students were introduced to concept of cells where they learned the major structures including cell membrane, cytoplasm, nucleus, and vacuole. In high school Biology, students will study the cell theory and explain how cell differentiation serves as the basis for the hierarchical organization of organisms. This is the first time that students have studied levels of organization within the human body.

It is essential for students to know that the human body is divided into specific levels of organization and that these levels are what make the human body a complex organism. The levels of organization, from the simplest level to the most complex are:

Cells

- The basic units of structure and function within the human body.
- Though all cells perform the processes that keep humans alive, they also have specialized functions as well.
- Examples may be nerve cells (neurons), blood cells, and bone cells.

Tissues

- A group of specialized cells that work together to perform the same function. There are four basic types of tissue in the human body:
 - *Nerve tissue*—carries impulses back and forth to the brain from the body
 - *Muscle tissue* (cardiac, smooth, skeletal)—contracts and shortens, making body parts move
 - *Epithelial tissue*—covers the surfaces of the body, inside (as lining and/or covering of internal organs) and outside (as layer of skin)
 - *Connective tissue*—connects all parts of the body and provides support (for example tendons, ligaments, cartilage)

Organs

- A group of two or more different types of tissue that work together to perform a specific function.
- The task is generally more complex than that of the tissue.
- For example, the heart is made of muscle and connective tissues which function to pump blood throughout the body.

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Systems

- A group of two or more organs that work together to perform a specific function.
- Each organ system has its own function but the systems work together and depend on one another.
- There are eleven different organ systems in the human body: circulatory, digestive, endocrine, excretory (urinary), immune, integumentary (skin), muscular, nervous, reproductive, respiratory, and skeletal.

It is not essential for students to know the major tenets of the cell theory or explain the process of cell differentiation as the basis for the hierarchical organization of organisms as these concepts will be further developed in high school biology.

Assessment Guidelines:

The objective of this indicator is to *summarize* the levels of structural organization within the human body; therefore, the primary focus of assessment should be to generalize major points about the different levels of organization (including cells, tissues, organs, and systems). However, appropriate assessments should also require student to *identify* the individual levels of organization; *illustrate* and ~~or~~ *exemplify* the levels of organization using words, pictures, or diagrams; ~~or~~ *classify* by sequencing the levels of organization; *exemplify* types of tissues; or *identify* the systems in the body.

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7.3.2 Recall the major organs of the human body and their functions within their particular body system.

Taxonomy level: 1.2-A, B Remember Factual and Conceptual Knowledge

Previous/Future knowledge: In kindergarten (K-3.2), students identified the functions of the sensory organs (including eyes, nose, ears, tongue, and skin). In 4th grade (4-2.3), students explained how humans use their sensory organs. This is the first time in science that students have been introduced to the human body and its functions. Students will *not* develop this concept further in high school biology because the focus will be at the cellular level.

It is essential for students to know that the human body consists of major organs that have specific functions required by the body to perform its life functions. Examples of major organs and their functions in the body are:

<i>System</i>	<i>Major Organs</i>	<i>Function (s)</i>
<i>Circulatory</i>	Heart	Causes blood to flow through the body by its pumping action
	Blood vessels (arteries, capillaries and veins)	<ul style="list-style-type: none"> • Tubes that carry blood throughout the entire body. • Most arteries carry blood that has oxygen and nutrients to all the parts of the body. • Most veins carry waste products (for example carbon dioxide) from all the parts of the body back to the heart. • <i>Capillaries</i> are very small vessels where oxygen and nutrients leave the blood to go into the cells and carbon dioxide and other waste products enter the blood from the cells. • <i>Blood</i> is composed of red blood cells, white blood cells, platelets, and plasma that have different functions.
<i>Respiratory</i>	Nose	Collects air from the environment and moistens and heats the air before it enters the trachea
	Trachea	The windpipe; moves air from the nose to the lungs
	Bronchi (sg., bronchus)	Tubes that move air from the trachea to the lungs; one bronchus leads to each lung; part of each bronchus is outside the lung and part is inside.
	Lungs	The main organs where gases are exchanged between air and the blood; the <i>alveoli</i> in the lungs are where the gas exchange takes place.
	Diaphragm	The muscle that aids in the breathing process

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<i>Digestive</i>	Mouth	Begins to break down food into smaller pieces through <i>mechanical digestion</i> ; saliva in the mouth starts the process of <i>chemical digestion</i>
	Esophagus	The transport tube that carries chewed food to the stomach
	Stomach	Continues the process of mechanical digestion; and secretes gastric juices that continue the process of chemical digestion started in the mouth
	Small intestines	The organ where most of the chemical digestion of food takes place; nutrients from food are also absorbed through the small intestines
	Large intestines	The organ where water is absorbed from the food and taken into the bloodstream; prepares the remaining undigested food for elimination from the body
	Rectum and anus	The rectum is a short tube that stores solid waste until it is eliminated from the body through the anus.
<i>Digestive</i>	Liver	A secondary organ of the digestive system that produces bile, which is used by the body to break up fat particles.
	Gallbladder	A secondary organ to the digestive system that functions to store bile produced by the liver.
	Pancreas	A secondary organ to the digestive system that functions to produce digestive juices that help to further break down the food in the small intestine.
<i>Excretory (Urinary)</i>	Kidneys	The two kidneys get rid of <i>urea</i> , excess water, and some other waste materials released by the cells. These are eliminated as <i>urine</i> .
	Ureters	Tubes which connect each kidney to the bladder
	Bladder	A saclike muscular organ which stores urine until it is released from the body
	Urethra	Tube through which urine passes before it is removed from the body

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<i>Nervous</i>	Brain	<p>An organ of the central nervous system, which has three distinct parts that all serve to control and coordinate the activities of the body.</p> <ul style="list-style-type: none"> • The <i>cerebrum</i> controls thoughts, voluntary actions, and the sensations related to the five senses. • The <i>cerebellum</i> helps with balance and coordination. • The <i>brain stem</i> is located at the base of the brain and controls vital and involuntary processes (for example, breathing, the beating of the heart, and digestion).
	Spinal cord	A bundle of nerves that begins at the brain stem and continues down the center of the back through the vertebrae. It connects with the peripheral nerves.
	Peripheral nerves	A network of nerves that branch out from the spinal cord and connect to the rest of the body and transmit signals to and from the brain through the spinal cord.
<i>Muscular</i>	Skeletal muscles	Voluntary muscles attached to bones and provide the force needed to move the bones; <i>tendons</i> connect the skeletal muscles to bones
	Smooth muscles	Involuntary muscles that control many types of movement within the body (such as digestion)
	Cardiac muscles	Involuntary muscle that forms the heart
<i>Skeletal</i>	Bones	<p>Provide shape and support for the body and protection for many organs and structures; some bones produce blood cells; some store minerals</p> <ul style="list-style-type: none"> • <i>Joints</i> occur where two or more bones meet • <i>Ligaments</i> attach bones at the joints
<i>Integumentary</i>	Skin	Covers the body and prevents the loss of water; it protects the body from infection and injury; it helps to regulate body temperature, get rid of wastes (sweat), receive information from the environment and produce vitamin D.

It is not essential for students to know the major organs of the reproductive system, immune system, endocrine system. The reproductive system will be studied in the health curriculum. Students do not need to know the pathway of blood through the circulatory system, the chemical processes (including names of enzymes) that occur during digestion, or name the bones of the body.

Assessment Guidelines:

The objective of this indicator is to *recall* the major organs of the human body and their function within their particular body system; therefore, the primary focus of assessment should be to

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remember information about the different organs and their major functions. However, appropriate assessments should also require student to *identify* the system that each organ belongs to; *recognize* an organ from words, pictures, or diagrams; or *identify* an organ based on the description of its function.

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7.3.3 Summarize the relationships of the major body systems (including the circulatory, respiratory, digestive, excretory, nervous, muscular, and skeletal systems).

Taxonomy level: 2.4-B Understand Conceptual Knowledge

Previous/Future knowledge: This is the first time in science that students have been introduced to the concept of the relationships between the major body systems. Students will not develop this concept further in high school Biology as the primary focus in that course will be at the cellular level.

It is essential for students to know that each system in the human body performs its own unique function.

Circulatory System

- The main function of the circulatory system is to transport blood to all parts of the body so that gases, nutrients, and waste products are transported to and from the cells.
- The white blood cells within the circulatory system help to fight infection in the body.

Respiratory System

- The main function of the respiratory system is to provide gas exchange between the blood and the air.
- When air is inhaled, the lungs remove some of the oxygen.
- Carbon dioxide is exhaled back into the environment.

Digestive System

- The main functions of the digestive system are to breakdown foods into nutrients that can be used by the body, absorb nutrients that are necessary for energy, growth, and maintenance, and rid the body of solid wastes.

Excretory System

- The main function of the excretory system is to filter out cellular wastes, toxins (chemicals that could be poisonous to the body), and excess water that result from cellular respiration.

Nervous System

- The main functions of the nervous system are to receive stimuli from inside and outside the body, to interpret the stimuli, and initiate responses for survival.

Muscular System

- The main function of the muscular system is to provide movement.

Skeletal System

- The main functions of the skeletal system are to provide support for the body, to protect internal organs, and to provide attachment sites for the muscles.

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Even though each system in the human body performs its own function, the different systems work together and depend on one another for the body to function successfully. Examples of relationships between the major body systems may be:

- All body systems are dependent upon the circulatory system to transport materials.
- The circulatory system works with the excretory system to help remove wastes from the body.
- The respiratory system works with the circulatory system to make sure that oxygen (O₂) reaches the bloodstream and carbon dioxide (CO₂) is removed from the bloodstream.
- The digestive system works with the circulatory system to make sure that nutrients made available by digestion (for example glucose) get to the cells of the body.
- The nervous system works with the muscular and skeletal systems to direct behavior and movement.
- The nervous system controls internal processes in the body (for example digestion and circulation).
- Muscles control the movement of materials through some organs (for example the stomach, intestines, and the heart).
- The muscular and skeletal systems work together to help the body move.

It is not essential for students to know the functions of the reproductive system, immune system, endocrine system, or integumentary system or how these systems work together. The chemical processes within each system are also not essential for this indicator.

Assessment Guidelines:

The objective of this indicator is to *summarize* the relationships between major body systems; therefore, the primary focus of assessment should be to generalize the major points about how the different systems listed in the indicator work together. However, appropriate assessments should also require student to *interpret* a diagram or illustration of interacting body systems; *identify* the function of the individual systems listed in the indicator; or *explain* how the systems listed in the indicator work together.

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7.3.4 Explain the effects of disease on the major organs and body systems (including infectious diseases such as colds and flu, AIDS, and athlete's foot and noninfectious diseases such as diabetes, Parkinson's, and skin cancer).

Taxonomy level: 2.7-B Understand Conceptual Knowledge

Previous/Future knowledge: This is the first time in science that students have been introduced to the concept of disease relating to the human body. In 6th grade (6-2.9), students studied the effect of disease-causing fungi on plants. Students will study the detection and treatment of some common communicable and chronic diseases and how disease processes affect the body systems in health, but students will *not* develop this concept further in high school Biology as the focus of that course of study will be at the cellular level.

It is essential for students to know that a *disease* is a condition that does not allow the body to function normally. Diseases can affect either an individual organ or an entire body system. Diseases are divided into two groups—infectious and noninfectious.

Infectious diseases are caused by tiny organisms called *pathogens*.

- These pathogens can be bacteria, viruses, fungi, or protists.
- These pathogens can come from another person, a contaminated object, an animal bite, or the environment.
- The *immune system* is responsible for distinguishing between the different kinds of pathogens and reacting to each according to its type.
- Once a pathogen has entered the body, it works by damaging individual cells within the organs or in some cases attacks an entire body system.

Examples of infectious diseases include:

Colds

- An illness caused by a viral infection located in the respiratory system.
- Once inside the human body, the cold virus multiplies and attacks the mucous membranes of the nose and throat causing the common effects of the cold (for example, sore throat, runny nose or fever).
- Because the cold is caused by a virus it cannot be treated with an antibiotic.

Flu

- *Influenza*, commonly known as "the flu," is a highly contagious viral infection of the respiratory system.
- Influenza typically causes fever, muscle aches, and a more severe cough than the common cold and usually lasts longer.

Athlete's foot

- A common fungal infection of the skin of the feet.
- The fungus may be contracted from public environments and then grows in the warm and moist environment usually between the toes, and can be difficult to cure.

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AIDS

- Acquired immunodeficiency syndrome (AIDS) is caused by the human immunodeficiency virus (HIV).
- This virus attacks the cells in the immune system making the organism unable to fight off other pathogens that may attack the body.

NOTE TO TEACHER: Caution should be taken when discussing AIDS with students. Follow guidelines as prescribed by the Health curriculum.

Strep throat

- Strep throat is a contagious disease caused by bacterial infection.
- Strep throat symptoms include fever, pain, redness, and swelling of the throat and tonsils.
- Strep throat may produce mild or severe symptoms.

NOTE TO TEACHER: Other examples of infectious diseases that are included in the Health curriculum are tetanus (caused by bacteria), pneumonia (caused by a virus or bacteria), or malaria (caused by a protist spread by mosquitoes).

Noninfectious diseases are diseases that are not caused by pathogens in the body.

- They are not spread from organism to organism.
- These diseases are caused by malfunctions in body systems that are either inherited or caused by environmental factors.

Examples of noninfectious diseases include:

Diabetes

- A disease that results in the glucose (sugar) level of the blood being higher than the normal range.
- It is caused by a person's inability to either produce or use properly a natural chemical produced in the body called *insulin*.
- The higher level of blood sugar results in many disorders of the body, for example an increase in problems with circulation of blood.
- Diabetes can lead to kidney disease or heart disease or cause vision problems.

Parkinson's disease

- A disease of the nervous system that occurs when certain nerve cells in the brain stop functioning properly, affecting the muscular system.
- The major symptoms are severe shaking (tremors) and disabilities involving movement.
- At present, there is no cure for Parkinson's disease.

Skin Cancer

- A disease in which skin cells found in the outer layers of the skin becomes damaged.
- Factors that can lead to skin cancer are damaging ultraviolet rays (UV) from the Sun or tanning beds and heredity.

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Asthma

- Asthma is a disease that affects the lungs and the airways that deliver air to the lungs.
- It causes periodic attacks of wheezing and difficult breathing.
- An asthma attack occurs when the airways become inflamed in response to a stimulus, such as dust, mold, pets, exercise, or cold weather.
- However, some attacks start for no apparent reason.

NOTE TO TEACHER: Other examples of noninfectious diseases that are included in the Health curriculum are allergies, arthritis, heart disease, or multiple sclerosis.

It is not essential for students to know how the immune system specifically responds to different pathogens (for example T-cells and B cells) or to go into depth regarding other diseases of the human body.

Assessment Guidelines:

The primary focus of this indicator is to *explain* the effects of disease on the major organs and body systems; therefore, the primary focus of assessment should be to construct a cause-and-effect model of how infectious and noninfectious diseases affect the organs and systems of the body. However, appropriate assessments should also require students to *classify* the identified diseases as infectious or noninfectious; *identify* which organ or system the disease affects; *identify* the common causes of infectious diseases; or *summarize* the characteristics of a particular disease.